

CLAIMS

We claim:

1. A wheat plant comprising at least one *Triticum aestivum* IMI nucleic acid selected from the group consisting of:
 - (a) an Imi1 nucleic acid encoding an IMI polypeptide which comprises a mutation in Domain E that results in a serine to asparagine substitution in the IMI protein as compared to a wild-type AHAS protein; and
 - (b) an Imi3 nucleic acid encoding an IMI polypeptide which comprises a mutation in Domain E that results in a serine to asparagine substitution in the IMI protein as compared to a wild-type AHAS protein;wherein the *Triticum aestivum* IMI nucleic acid confers upon the plant increased tolerance to an imidazolinone herbicide as compared to a wild-type variety of the plant.
2. The wheat plant of claim 1, wherein the plant comprises the Imi1 nucleic acid of (a).
3. The wheat plant of claim 1, wherein the plant comprises the Imi3 nucleic acid of (b).
4. The wheat plant of claim 1, wherein the plant comprises a first *Triticum aestivum* IMI nucleic acid and a second *Triticum aestivum* IMI nucleic acid, the first *Triticum aestivum* IMI nucleic acid is the IMI nucleic acid of (a) or (b), and the second *Triticum aestivum* IMI nucleic acid is selected from the group consisting of an Imi1 nucleic acid, an Imi2 nucleic acid, and an Imi3 nucleic acid.
5. The wheat plant of claim 4, wherein the second *Triticum aestivum* IMI nucleic acid encodes an IMI polypeptide comprising a mutation in a conserved amino acid sequence selected from the group consisting of a Domain A, a Domain B, a Domain C, a Domain D and a Domain E.
6. The wheat plant of claim 5, wherein the conserved amino acid sequence is a Domain E.

7. The wheat plant of claim 6, wherein the mutation results in a serine to asparagine substitution in the second IMI protein as compared to a wild-type AHAS protein.

8. The wheat plant of claim 1, wherein the at least one *Triticum aestivum* IMI nucleic acid comprises a polynucleotide sequence selected from the group consisting of:

- (i) a polynucleotide as defined in SEQ ID NO:1;
- (ii) a polynucleotide as defined in SEQ ID NO:3;
- (iii) a polynucleotide encoding a polypeptide as defined in SEQ ID NO:2;
- (iv) a polynucleotide encoding a polypeptide as defined in SEQ ID NO:4;
- (v) a polynucleotide comprising at least 60 consecutive nucleotides of any of (i) through (iv) above; and
- (vi) a polynucleotide complementary to the polynucleotide of any of (i) through (v) above.

9. The wheat plant of claim 1, wherein the Imi1 nucleic acid comprises a polynucleotide sequence as defined in SEQ ID NO:1.

10. The wheat plant of claim 1, wherein the Imi3 comprises a polynucleotide sequence as defined in SEQ ID NO:3.

11. The wheat plant of any one of claims 1, 4, 5, 6, and 7, said plant comprising two *Triticum aestivum* IMI nucleic acids.

12. The wheat plant of claim 11, comprising an Imi1 nucleic acid and an Imi3 nucleic acid.

13. The wheat plant of any one of claims 1, 4, 5, 6, and 7, said plant comprising three *Triticum aestivum* IMI nucleic acids.

14. The wheat plant of claim 1, wherein the plant is not transgenic.

15. The wheat plant of claim 1, wherein the imidazolinone herbicide is selected from the group consisting of 2-(4-isopropyl-4-methyl-5-oxo-2-imidiazolin-2-yl)-nicotinic acid, 2-(4-isopropyl-4-methyl-5-oxo-2-imidazolin-2-yl)-3-quinolinecarboxylic acid, 5-ethyl-

2-(4-isopropyl-4-methyl-5-oxo-2-imidazolin-2-yl)-nicotinic acid, 2-(4-isopropyl-4-methyl-5-oxo-2-imidazolin-2-yl)-5-(methoxymethyl)-nicotinic acid, 2-(4-isopropyl-4-methyl-5-oxo-2-imidazolin-2-yl)-5-methylnicotinic acid, and a mixture of methyl 6-(4-isopropyl-4-methyl-5-oxo-2-imidazolin-2-yl)-m-toluate and methyl 2-(4-isopropyl-4-methyl-5-oxo-2-imidazolin-2-yl)-p-toluate.

16. The wheat plant of claim 1, wherein the imidazolinone herbicide is 5-ethyl-2-(4-isopropyl-4-methyl-5-oxo-2-imidazolin-2-yl)-nicotinic acid.

17. The wheat plant of claim 1, wherein the imidazolinone herbicide is 2-(4-isopropyl-4-methyl-5-oxo-2-imidazolin-2-yl)-5-(methoxymethyl)-nicotinic acid.

18. A plant part of the wheat plant of claim 1.

19. A plant cell of the wheat plant of claim 1.

20. A seed produced by the wheat plant of claim 1, wherein the seed comprises at least one *Triticum aestivum* IMI nucleic acid selected from the group consisting of the *Triticum aestivum* IMI nucleic acids of (a) and (b).

21. The seed of claim 24, wherein the seed is true breeding for an increased resistance to an imidazolinone herbicide as compared to a wild type variety of the wheat plant seed.

22. A wheat plant comprising the herbicide resistance characteristics of the plant with American Type Culture Collection (ATCC) Patent Deposit Designation Number PTA-4256 or PTA-4257, wherein:

- (a) the wheat plant has an ATCC Patent Deposit Designation Number PTA-4256 or PTA-4257;
- (b) the wheat plant is a recombinant or genetically engineered derivative of the plant with ATCC Patent Deposit Designation Number PTA-4256 or PTA-4257;
- (c) the wheat plant is any progeny of the plant with ATCC Patent Deposit Designation Number PTA-4256 or PTA-4257; or

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(d) the wheat plant is a progeny of any of the plants of (a) through (c).

23. The wheat plant of claim 22, wherein the imidazolinone herbicide is selected from the group consisting of 2-(4-isopropyl-4-methyl-5-oxo-2-imidazolin-2-yl)-nicotinic acid, 2-(4-isopropyl-4-methyl-5-oxo-2-imidazolin-2-yl)-3-quinolinecarboxylic acid, 5-ethyl-2-(4-isopropyl-4-methyl-5-oxo-2-imidazolin-2-yl)-nicotinic acid, 2-(4-isopropyl-4-methyl-5-oxo-2-imidazolin-2-yl)-5-(methoxymethyl)-nicotinic acid, 2-(4-isopropyl-4-methyl-5-oxo-2-imidazolin-2-yl)-5-methylnicotinic acid, and a mixture of methyl 6-(4-isopropyl-4-methyl-5-oxo-2-imidazolin-2-yl)-m-toluate and methyl 2-(4-isopropyl-4-methyl-5-oxo-2-imidazolin-2-yl)-p-toluate.

24. The wheat plant of claim 22, wherein the imidazolinone herbicide is 5-ethyl-2-(4-isopropyl-4-methyl-5-oxo-2-imidazolin-2-yl)-nicotinic acid.

25. The wheat plant of claim 22, wherein the imidazolinone herbicide is 2-(4-isopropyl-4-methyl-5-oxo-2-imidazolin-2-yl)-5-(methoxymethyl)-nicotinic acid.

26. A plant part of the wheat plant of claim 22.

27. A plant cell of the wheat plant of claim 22.

28. A triticales plant comprising at least one *Triticum aestivum* IMI nucleic acid selected from the group consisting of:

- (a) an Imi1 nucleic acid encoding an IMI polypeptide which comprises a mutation in Domain E that results in a serine to asparagine substitution in the IMI protein as compared to a wild-type AHAS protein; and
- (b) an Imi3 nucleic acid encoding an IMI polypeptide which comprises a mutation in Domain E that results in a serine to asparagine substitution in the IMI protein as compared to a wild-type AHAS protein;

wherein the *Triticum aestivum* IMI nucleic acid confers upon the plant increased tolerance to an imidazolinone herbicide as compared to a wild-type variety of the plant.

29. The triticales plant of claim 28, wherein the triticales plant comprises the Imi1 nucleic acid of (a).

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30. The tritcale plant of claim 28, wherein the tritcale plant comprises the Imi3 nucleic acid of (b).

31. The tritcale plant of claim 28, wherein the tritcale plant comprises a first *Triticum aestivum* IMI nucleic acid and a second *Triticum aestivum* IMI nucleic acid, the first *Triticum aestivum* IMI nucleic acid is the IMI nucleic acid of (a) or (b), and the second *Triticum aestivum* IMI nucleic acid is selected from the group consisting of an Imi1 nucleic acid, an Imi2 nucleic acid, and an Imi3 nucleic acid.

32. The tritcale plant of claim 31, wherein the second *Triticum aestivum* IMI nucleic acid encodes an IMI polypeptide comprising a mutation in a conserved amino acid sequence selected from the group consisting of a Domain A, a Domain B, a Domain C, a Domain D and a Domain E.

33. The tritcale plant of claim 32, wherein the conserved amino acid sequence is a Domain E.

34. The tritcale plant of claim 33, wherein the mutation results in a serine to asparagine substitution in the second IMI protein as compared to a wild-type AHAS protein.

35. The tritcale plant of claim 28, wherein the at least one *Triticum aestivum* IMI nucleic acid comprises a polynucleotide sequence selected from the group consisting of:

- (i) a polynucleotide as defined in SEQ ID NO: 1;
- (ii) a polynucleotide as defined in SEQ ID NO:3;
- (iii) a polynucleotide encoding a polypeptide as defined in SEQ ID NO:2;
- (iv) a polynucleotide encoding a polypeptide as defined in SEQ ID NO:4;
- (v) a polynucleotide comprising at least 60 consecutive nucleotides of any of (i) or (iv) above; and
- (vi) a polynucleotide complementary to the polynucleotide of any of (i) through (v) above.

36. The tritcale plant of claim 28, wherein the Imi1 nucleic acid comprises a polynucleotide sequence as defined in SEQ ID NO:1.

37. The triticales plant of claim 28, wherein the Imi3 nucleic acid comprises a polynucleotide sequence as defined in SEQ ID NO:3.

38. The triticales plant of any one of claims 28, 31, 32, 33, and 34, said plant comprising two *Triticum aestivum* IMI nucleic acids.

39. The triticales plant of claim 38, comprising a *Triticum aestivum* Brookton Imi1 nucleic acid and a *Triticum aestivum* Krichauff Imi3 nucleic acid.

40. A plant part of the triticales plant of claim 28.

41. A plant cell of the triticales plant of claim 28.

42. A seed produced by the triticales plant of claim 28, wherein the seed comprises at least one *Triticum aestivum* IMI nucleic acid selected from the group consisting of the *Triticum aestivum* IMI nucleic acids of (a) and (b).

43. The seed of claim 42, wherein the seed is true breeding for an increased tolerance to an imidazolinone herbicide as compared to a wild type variety of the triticales plant seed.

44. A triticales plant comprising the herbicide resistance characteristics of the plant with ATCC Patent Deposit Designation Number PTA-4256 or PTA-4257, wherein:

- (a) the triticales plant is a recombinant or genetically engineered derivative of the plant with ATCC Patent Deposit Designation Number PTA-4256 or PTA-4257;
- (b) the triticales plant is any progeny of the plant with ATCC Patent Deposit Designation Number PTA-4256 or PTA-4257; or
- (c) the triticales plant is a progeny of any of the plants of (a) through (b).

45. An isolated IMI nucleic acid, wherein the nucleic acid comprises a polynucleotide selected from the group consisting of:

- (a) a polynucleotide as defined in SEQ ID NO:1;

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- (b) a polynucleotide as defined in SEQ ID NO:3;
- (c) a polynucleotide encoding a polypeptide as defined in SEQ ID NO:2;
- (d) a polynucleotide encoding a polypeptide as defined in SEQ ID NO:4;
- (e) a polynucleotide comprising at least 60 consecutive nucleotides of any of (a) through (d) above; and
- (f) a polynucleotide complementary to the polynucleotide of any of (a) through (e) above.

46. The isolated IMI nucleic acid of claim 45, wherein the nucleic acid comprises a polynucleotide as defined in SEQ ID NO:1.

47. The isolated IMI nucleic acid of claim 45, wherein the nucleic acid comprises a polynucleotide as defined in SEQ ID NO:3.

48. The isolated IMI nucleic acid of claim 45, wherein the nucleic acid comprises a polynucleotide encoding a polypeptide as defined in SEQ ID NO:2.

49. The isolated IMI nucleic acid of claim 45, wherein the nucleic acid comprises a polynucleotide encoding a polypeptide as defined in SEQ ID NO:4.

50. A method of controlling weeds within the vicinity of a plant, comprising applying an imidazolinone herbicide to the weeds and the plant, wherein the plant has increased tolerance to the imidazolinone herbicide as compared to a wild type variety of the plant, and wherein the plant comprises at least one *Triticum aestivum* IMI nucleic acid selected from the group consisting of:

- (a) an Imi1 nucleic acid encoding an IMI polypeptide which comprises a mutation in Domain E that results in a serine to asparagine substitution in the IMI protein as compared to a wild-type AHAS protein; and
- (b) an Imi3 nucleic acid encoding an IMI polypeptide which comprises a mutation in Domain E that results in a serine to asparagine substitution in the IMI protein as compared to a wild-type AHAS protein.

51. The method of claim 50, wherein the plant comprises an Imi1 nucleic acid and an Imi3 nucleic acid.

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52. The method of claim 50, wherein the at least one *Triticum aestivum* IMI nucleic acid is selected from the group consisting of:

- (i) a polynucleotide as defined in SEQ ID NO:1;
- (ii) a polynucleotide as defined in SEQ ID NO:3;
- (iii) a polynucleotide encoding a polypeptide as defined in SEQ ID NO:2;
- (iv) a polynucleotide encoding a polypeptide as defined in SEQ ID NO:4;
- (v) a polynucleotide comprising at least 60 consecutive nucleotides of any of (i) through (iv) above; and
- (vi) a polynucleotide complementary to the polynucleotide of any of (i) through (v) above.

53. The method of claim 50, wherein the plant comprises the Imi3 nucleic acid of (b).

54. The method of claim 50, wherein the at least one *Triticum aestivum* IMI nucleic acid is selected from the group consisting of:

- (i) a polynucleotide as defined in SEQ ID NO:3;
- (ii) a polynucleotide encoding a polypeptide as defined in SEQ ID NO:4;
- (iii) a polynucleotide comprising at least 60 consecutive nucleotides of any of (i) through (ii) above; and
- (iv) a polynucleotide complementary to the polynucleotide of any of (i) through (iii) above.

55. A method of modifying a plant's tolerance to an imidazolinone herbicide comprising modifying the expression of at least one *Triticum aestivum* IMI nucleic acid selected from the group consisting of:

- (a) an Imi1 nucleic acid encoding an IMI polypeptide which comprises a mutation in Domain E that results in a serine to asparagine substitution in the IMI protein as compared to a wild-type AHAS protein; and
- (b) an Imi3 nucleic acid encoding an IMI polypeptide which comprises a mutation in Domain E that results in a serine to asparagine substitution in the IMI protein as compared to a wild-type AHAS protein.

SUBSTITUTE SHEET

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56. The method of claim 55, wherein the plant comprises an Imi1 nucleic acid and an Imi3 nucleic acid.

57. The method of claim 55, wherein the at least one IMI nucleic acid is selected from the group consisting of.

- (i) a polynucleotide as defined in SEQ ID NO:1;
- (ii) a polynucleotide as defined in SEQ ID NO:3;
- (iii) a polynucleotide encoding a polypeptide as defined in SEQ ID NO:2;
- (iv) a polynucleotide encoding a polypeptide as defined in SEQ ID NO:4;
- (v) a polynucleotide comprising at least 60 consecutive nucleotides of any of (i) through (iv) above; and
- (vi) a polynucleotide complementary to the polynucleotide of any of (i) through (v) above.

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ICTA01/2167995v1

PCT/IB2003/004645